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**IFAORS**

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National Aeronautics and Space Administration  
George C. Marshall Space Flight Center  
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Contract: NAS8-35594

Subject: Monthly Progress Report--Development of a Global Model for  
Atmospheric Backscatter at CO<sub>2</sub> Wavelengths

Period: March 14 - April 13, 1984

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## Introduction

Work has continued on the tasks shown below.

Task 1.2 To investigate the effect of aerosol microphysical processing, occurring in an aerosol plume which undergoes transport in the atmosphere, on its  $\beta_{CO_2}$  value.

In the previous Monthly Report (March 21, 1984), we have described the effect of gravitational sedimentation on the atmospheric aerosol size distribution. This effect had been successfully simulated by using a one-layer numerical model appropriate for a 1 km thick layer at an altitude of 7 km. It is well known that the gravitational sedimentation leads to significant interaction between size distribution in different layers. More specifically, the evolution of the size distribution of one layer depends strongly on the size distribution of the layers above. In order to incorporate this dependence into the analysis, a multi-layer model is under development. It includes ten layers above the earth's surface, each of 1 km thickness. The U.S. Standard Atmosphere 1976 is used as the background atmosphere. It is anticipated that the result of this multi-layer model will enable us to study the evolution of the size distribution of each of these layers in detail and also allow us to examine the changes in the vertical distribution of aerosol size parameters with time.

As mentioned earlier (Monthly Report, February 21, 1984), a non-linear curve fitting program is being developed for the purpose of studying the evolution of the aerosol size parameters ( $r_m$ ,  $\sigma_g$ ,  $n_0$ ). This fitting process is currently working successfully. We are now developing a computer routine which will display the results of this fitting graphically.

**Task 2.1 Use of the SAGE/SAM II data set.**

Work has continued on the study of the SAGE/SAM II data and its use to establish the geographical and temporal variation of the aerosol concentration in the free troposphere. The following specific tasks have been accomplished.

1. The alternative version of the SAGE program, including the probability distribution, has been completed and checked. It is now operational.
2. The basic version of the SAM II program is operational, the alternative version, including probability distributions, is still being tested.
3. The SAGE program has been made more flexible so that it can handle not only extinction data obtained at  $1.00\text{ }\mu\text{m}$ , but also the extinction ratio for measurements at  $0.45\text{ }\mu\text{m}$  and  $1.00\text{ }\mu\text{m}$ . Unfortunately,  $0.45\text{ }\mu\text{m}$  data does not extend to altitudes below 10 km, but it is hoped that some useful tropospheric data will be available for low latitudes, where the tropopause altitude is close to 16 km.
4. After examination of the preliminary 6-week data set, a 3-month season (March-May 1980) has been processed in detail. The results of this analysis are still being plotted and are under study. Many of the data sub-sets (e.g., land in the southern hemisphere), contain insufficient numbers of individual observations for statistical significance and further data sets will need to be studied before trends can be established. From the data already examined, it is clear that, above about 6 km, latitudinal differences are far more important in determining the aerosol concentration than the surface conditions. This is exemplified in Figs. 1 and 2 which show the median extinction for various surface type sub-sets within the latitude belts 20-60 N and 20-60 S. In both figures, the individual curves agree within the limits of error for altitudes above 6 km. The curves for the different latitudes differ by a factor of 3-4 at a height of 6 km, well outside the limits of error. Below 6 km, the data is sparser due to data loss caused by obscuration at higher altitudes. The error bars increase in magnitude and it is not clear if there is any significant difference between the sub-sets. It should also be noted that, at these heights, due to selective data loss, the remaining data is likely to be biased. This is particularly evident in Fig. 1, where the apparent extinction at an altitude of 1-2 km is lower than that at 4-5 km. This is unlikely to reflect a real trend in the atmosphere but reflects the fact that the extinction at 1-2 km can only be measured by using space-borne instruments at times when the atmosphere is extremely clean.

Dr. D. E. Fitzjarrald  
NASA-Marshall  
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Research Schedule for Next Month

1. To continue work on the multi-layer numerical model described under Task 1.2.
2. Continuation of work under Task 2.1. The version of the SAM II program that includes the probability distribution will be tested. A further 3-month data set for SAGE will be analyzed and compared to the original Spring 1980 data set. Probability distributions will be examined in detail.

Remarks

No problems encountered.

  
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G. S. Kent

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# SAGE AEROSOL COMPARISON

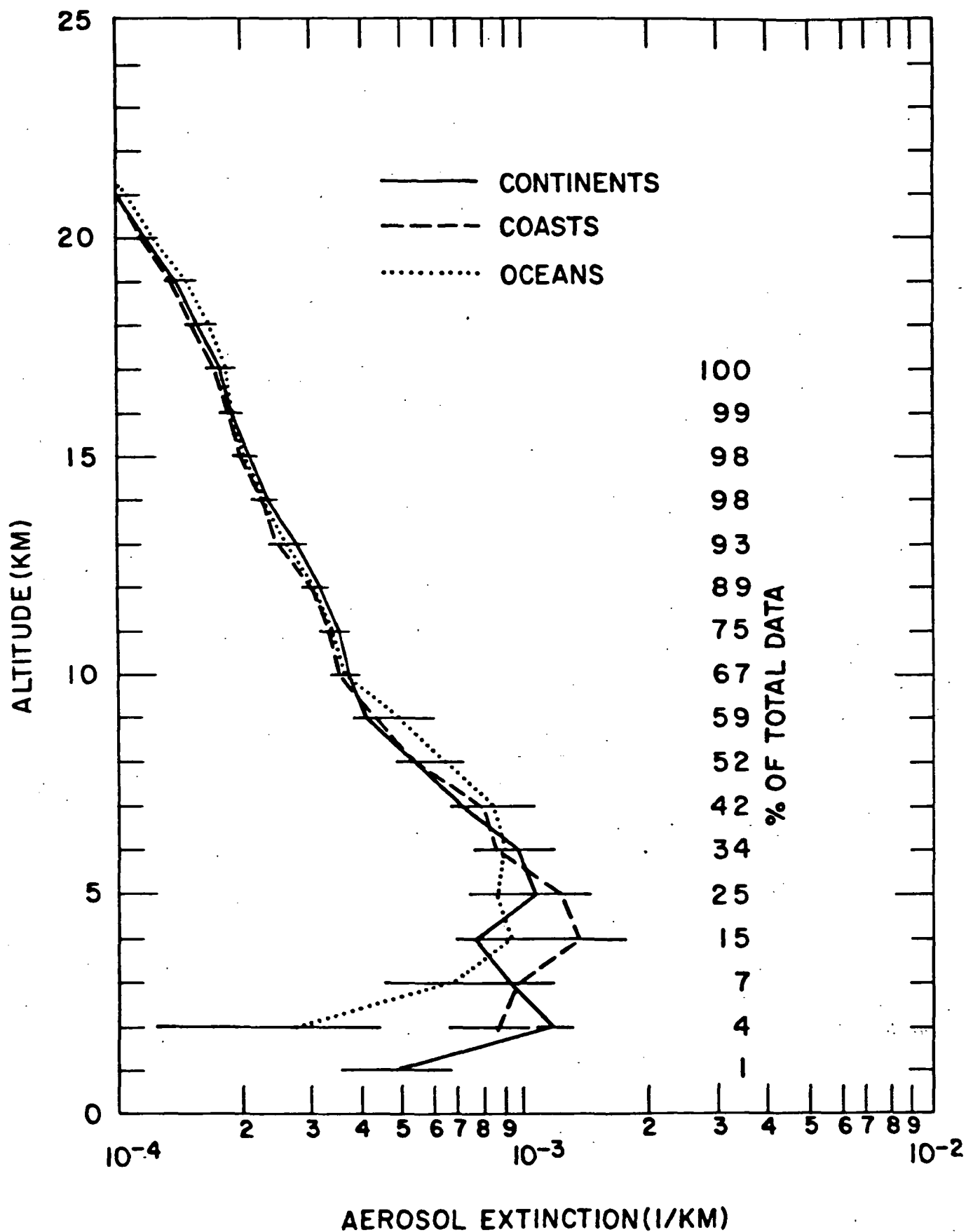


Figure 1. Median extinction values at 1  $\mu\text{m}$  wavelength for different surface type sub-sets in the latitude belt 20-60 N.

# SAGE AEROSOL COMPARISON

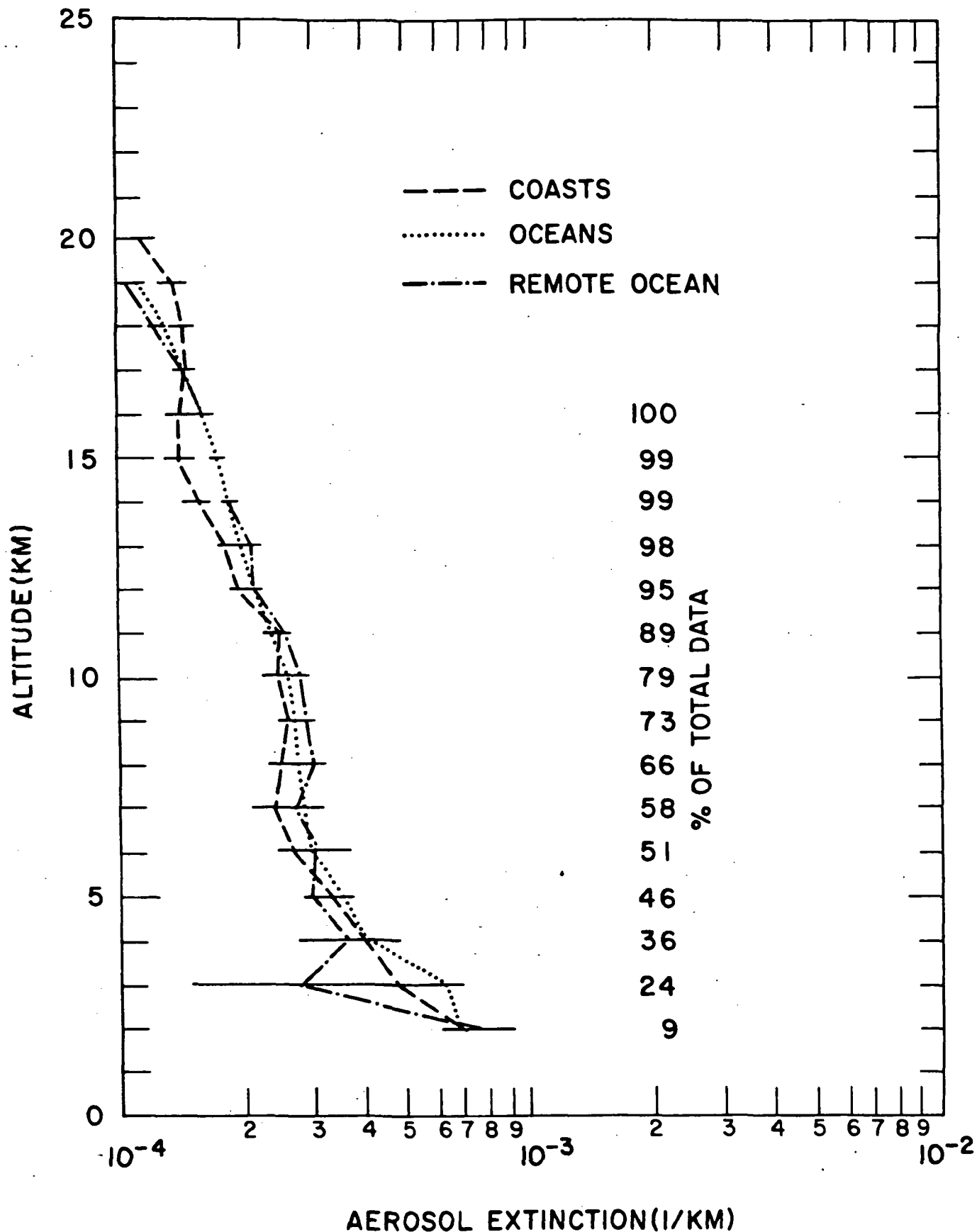


Figure 2. Median extinction values at 1  $\mu$ m wavelength for different surface type sub-sets in the latitude belt 20-60 S.